PERFORMANCE EVALUATION OF CACHING TECHNIQUES FOR VIDEO ON DEMAND WORKLOAD IN NAMED DATA NETWORK

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Abstrak

Penggunaan Internet dalam konteks kontemporari berkembang pesat terutamanya untuk tujuan paparan maklumat. Ini disebabkan oleh kemunculan 'Information-Centric Networking' (ICN) dalam domain yang lebih luas iaitu akademik dan industri. 'Named Data Network (NDN)' adalah hasil daripada ICN. Di samping itu, NDN diutamakan sebagai seni bina untuk trafik video yang lancar diantara permintaan dan penerima video dalam talian. Penyelidikan ringkas ini mengenal pasti isu semasa yang menyebabkan kesesakan di beban kerja 'Video on Demand' (VoD) yang berpunca daripada penyimpanan kerap objek kandungan dalam repositori tempatan, yang membawa kepada masalah penampanan dan kehilangan paket data. Kajian itu akan menilai teknik cache NDN untuk memilih teknik penggantian cache yang lebih sesuai untuk menangani isu-isu kesesakan, dan menilai prestasinya. Untuk demikian, kajian semasa menggunakan proses penyelidikan berdasarkan 'Design Research Methodology' (DRM) dan pendekatan VoD untuk menerangkan aktiviti-aktiviti utama yang menghasilkan peningkatan dalam hasil akhir penyelidikan. Kumpulan data, serta topologi rangkaian Internet2 dan statistik tontonan video telah dikumpulkan dari platform PPTV. Sebanyak 221 pelayan disambungkan kepada rangkaian dari pusat akses yang sama seperti dalam penggunaan sebenar PPTV. Di samping itu, NS3 menganalisa prestasi metrik teknik penggantian caching (LRU, LFU dan FIFO) untuk VoD dalam 'Named Data Network' (NDN) dari segi nisbah hit cache, pemprosesan, dan keputusan beban pelayan dalam hasil yang munasabah yang muncul berkhidmat sebagai pengganti yang berpotensi dengan pelaksanaan topologi semasa Internet2, di mana nod diedarkan secara rawak. Berdasarkan keputusan, teknik LFU memberikan hasil yang lebih baik untuk kesesakan di antara teknik-teknik lain yang dibentangkan. Akhir sekali, kajian ini mendapati bahawa prestasi metric nisbah cache, kendalian, dan beban pelayan untuk LFU menghasilkan kadar kesesakan yang paling rendah dan mencukupi. Justeru, penyelidik membuat kesimpulan bahawa kecekapan teknik penggantian yang berbeza perlu juga disiasat untuk memberikan pandangan serta idea untuk melaksanakan teknik-teknik ini dalam konteks tertentu. Walau bagaimanapun, keputusan ini memenuhi pemahaman semasa untuk teknik penggantian saiz cache yang berbeza. Setelah teknik penggantian yang berbeza diaplikasikan dan diperiksa, ciri-ciri prestasi dan prestasi jangkaan juga didapati merangsang model cache untuk berjalan cepat merentasi pelbagai aplikasi terbenam.

Kata-kunci: Information-Centric Networking (ICN), Named Data Network (NDN), Video on Demand (VoD), Congestion, Caching Replacement Techniques

Abstract

The rapid growing use of the Internet in the contemporary context is mainly for content distribution. This is derived primarily due to the emergence of Information-Centric Networking (ICN) in the wider domains of academia and industry. Named Data Network (NDN) is one of ICN architectures. In addition, the NDN has been emphasized as the video traffic architecture that ensures smooth communication between the request and receiver of online video. The concise research problem of the current study is the issue of congestion in Video on Demand (VoD) workload caused by frequent storing of signed content object in the local repositories, which leads to buffering problems and data packet loss. The study will assess the NDN cache techniques to select the preferable cache replacement technique suitable for dealing with the congestion issues, and evaluate its performance. To do that, the current study adopts a research process based on the Design Research Methodology (DRM) and VoD approach in order to explain the main activities that produced an increase in the expected findings at the end of the activities or research. Datasets, as well as Internet2 network topology and the statistics of video views were gathered from the PPTV platform. Actually, a total of 221 servers is connected to the network from the same access points as in the real deployment of PPTV. In addition, an NS3 analysis the performance metrics of caching replacement technique (LRU, LFU, and FIFO) for VoD in Named Data Network (NDN) in terms of cache hit ratio, throughput, and server load results in reasonable outcomes that appears to serve as a potential replacement with the current implementation of the Internet2 topology, where nodes are distributed randomly. Based on the results, LFU technique gives the preferable result for congestion from among the presented techniques. Finally, the research finds that the performance metrics of cache hit ratio, throughput, and server load for the LFU that produces the lowest congestion rate which is sufficient. Therefore, the researcher concluded that the efficiency of the different replacement techniques needs to be well investigated in order to provide the insights necessary to implement these techniques in certain context. However, this result enriches the current understanding of replacement techniques in handling different cache sizes. After having addressed the different replacement techniques and examined their performances, the performance characteristics along with their expected performance were also found to stimulate a cache model for providing a relatively fast running time of across a broad range of embedded applications.

Keywords: Information-Centric Networking (ICN), Named Data Network (NDN), Video on Demand (VoD), Congestion, Caching Replacement Techniques

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In the name of ALLAH, Most Gracious, Most Merciful:

"*Work; so Allah will see your work and (so will) His Messenger and the believers*;"

(The Holy Quran - AtTawbah 9:105)

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List of Abbreviations

ABR	-	Adaptive-Bit-Rate
ADSL	-	Asymmetric Digital Subscriber Line
CDN	-	Content Delivery Network
CS	-	Content Store
DoS	-	Denial-of-Service attack
FIB	-	Forwarding Information Base
FIFO	-	First-In-First-Out police
ID	-	IDentifier
IP	-	Internet Protocol
IPTV	-	Internet Protocol Television
ISP	-	Internet Service Provider
LFU	-	Least Frequently Used
LRU	-	Least Recently Used
NDN	-	Named Data Networking
NLR	-	National Lambda Rail
NS3	-	Network Simulation version 3
PC	-	Personal Computer
PIT	-	Pending Interest Table
PPTV	-	Platform Provider Television
P2P	-	Peer-to-Peer
TCP	-	Transmission Control Protocol
UCLA	-	University of California, Los Angeles
URL	-	Uniform Resource Locator
VoD	-	Video-on-Demand
TCP/IP	-	Transmission Control Protocol/Internet Protocol

CHAPTER ONE
INTRODUCTION

This chapter provides an overview of this study. It includes a brief introduction of Named Data Networking (NDN) technique and its application such as Video-on-Demand. Besides, the chapter contains the research problem and the research questions which are in line with the research objectives. The scope and significance of this research is also explained in this chapter.

1.1 Background of the Study

Named Data Networking (NDN) has been identified as the communication architecture used in an Internet video storage. It gives high priority to the data which include videos. The NDN architecture is basically comprised of communication units as shown in Figure 1.1 as interest packet and data packet [1].

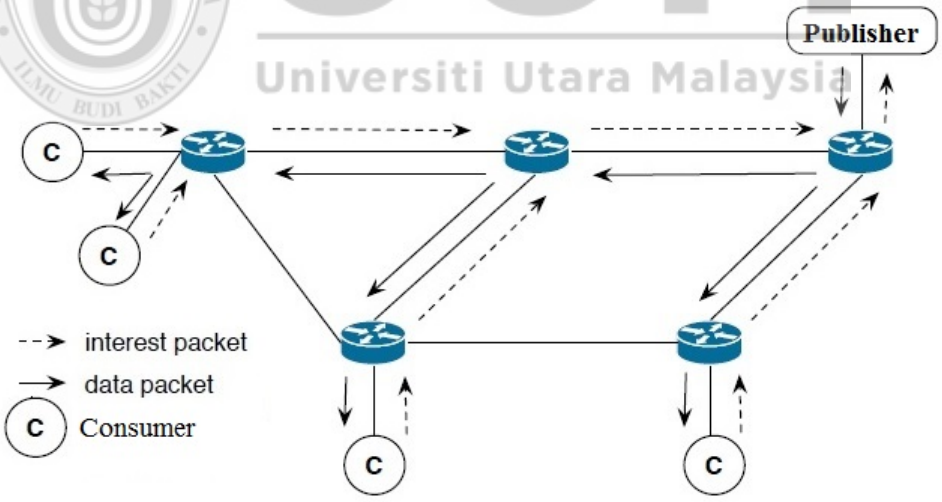

Figure 1.1: Data Flow in NDN Architecture [1]

The interest packet is one of the communication units in NDN sent upon the request of consumers of data or video steaming, while the data packet is protected by a cryptographic signature giving most integrity of the data video source from the cache.

The contents of the thesis is for internal user only

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